THRAUSTOTHECA CLAVATA

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(With Plate 63, Containing 10 Figures)

During the course of our study of the Saprolegniaceae we brought into the laboratory early in January, 1911, a number of collections from promising pools and runs. Several different species developed in a couple of days. One of these taken from an open ditch in the arboretum was at once conspicuous on account of its stout hyphae and irregular branches. This soon developed club-shaped sporangia and by its method of spore liberation was at once recognized as the rare and interesting species *Thraustotheca clavata* (De Bary) Humphrey.

This mold seems not to have been found since its first discovery in 1880. In 1888 De Bary described it as a new species under the name of *Dictyuchus clavatus*.[1] He got his specimens from a collection of algal material taken in 1880 by Stahl from a fresh-water lake at Vendenheim near Strassburg, Germany, and kept it growing in his laboratory for four years. The species was really first published incidentally by Büsgen in 1882,[2] who in his study of the development of the sporangia described it sufficiently under the name of *Dictyuchus clavatus* De Bary sp. nov.

On account of the unparalleled method of spore liberation it was suggested by Solms-Laubach, who, after De Bary's death, arranged and edited his last paper, that this species might be considered as generically distinct from the other species of *Dictyuchus*. This was again remarked on by Fisher in 1892,[3] and the next year, Humphrey in his Saprolegniaceae of the United States was sufficiently impressed with its distinction to give it the generic name of *Thraustotheca*.

A pure culture of our Chapel Hill plant was obtained as fol-

[1] Bot. Zeitung 46: 649. 1888.

[2] Pringsheim's Jahrb. f. wiss. Botanik, 13: 253. 1882.

[3] Rabenhorst's Kryptagamen Flora 1: 365. 1892.

lows: A petri dish of sterilized agar-agar was inoculated with a drop of water containing free spores. After a few hours the spores sprouted. When the young fungus had grown sufficiently to be discernible with the naked eye it was cut out, together with the immediately surrounding medium and transplanted to a dish of fresh agar-agar. When the growth had become quite robust flies were inoculated, and fine cultures soon resulted. The species was kept growing and under observation for the rest of the term.

The main hyphae of *Thraustotheca* are stout, straight, and profusely branching into secondary hyphae near their tips. The secondary hyphae are much curved and twisted, and are often curiously knobbed and gnarled as shown in fig. 1. The main hyphae reach a length of 2 cm. in strong cultures, and vary in diameter from 20μ to 120μ averaging about 37μ. The sporangia are borne terminally, the hypha continuing from a sub-sporangial branch (fig. 2). The sporangia are typically short, broad, and clavate, differing from the sporangia of any other of the Saprolegniaceae. They vary from almost spherical on the one hand to fusiform on the other. The spores encyst within the sporangium immediately after they are formed. They are polyhedral in shape, through pressure, each having a hyaline membrane of its own (fig. 3). After the encysting of the spores, the sporangial wall, which has always been thin, begins to disappear, vanishing first as a rule on one side near the end of the club, and continuing to disintegrate until nothing is left of it except a narrow circular ring at the base. This basal ring may be quite conspicuous (figs. 4 and 5) or almost entirely absent.

This method of dehiscence is entirely unique among the water molds, and reminds us at once of the mold *Mucor* and its relatives. This resemblance was remarked on at the time the plant was described, and Solms-Laubach thought he saw another point of agreement between *Mucor* and our plant in the outward bulging of the basal partition. This, however, seems to us to be scarcely if at all noticeable in *Thraustotheca*. De Bary's figures show it scarcely at all, and neither do ours.

As the disintegration of the wall proceeds the spores fall apart irregularly. They then emerge from their cysts and swarm in

laterally biciliate form. Finally they encyst again and sprout. At the time of the final encystment the spores are of course spherical, measuring about 12.5μ in diameter.

The oögonia are borne singly on short, straight, perpendicular branches from the secondary hyphae, rarely from the primaries. At the time when the eggs are fully ripe the oögonia measure about 59μ in diameter. They are spherical, smooth, and very slightly pitted, the pits appearing only after staining with chlorzinc-iodide. Each oögonium contains from 1 to 8 eggs (fig. 6). The usual number of eggs is either 4 or 6. Ripe eggs are spherical or slightly angular from pressure, excentric, with a single large peripheral oil globule (fig. 6). They are very constant as to size with a diameter of from 20μ to 22μ. The antheridial branches also arise from the secondary hyphae. They are long, very crooked, and quite stout. The ends of the antheridial branches become closely applied to the surface of the oögonium, and club-shaped antheridia are cut off from their tips (fig. 7). In many cases it was noted that the antheridium gave off a short tube which entered the oögonium and became applied to an egg (fig. 6). The actual fertilization of the egg was never seen but the antheridia were observed to become empty during the ripening of the eggs. In no case was it found that an antheridial tube became attached to an oögonium arising from the same hypha as itself.

The formation of the oögonia and eggs may be easily watched in this species. The protoplasm of the hypha flows out into the oögonial branch, rapidly packing it with densely granular substance. The tip of the branch swells into a rounded sphere which is packed with a very dense protoplasm. This tip is then cut off from the oögonial branch by a cross wall and the oögonium has been formed.

The substance within the oögonium is at first entirely homogeneous. After some time it may be noticed that oil drops are collecting at the periphery of the protoplasmic mass (figs. 7, 8, and 10). The protoplasmic mass then begins to divide, the division beginning at the center and traveling towards the periphery. At first a clear space appears in the center of the mass from which radial spaces gradually extend outward. The eggs when

first separated are roughly pyramidal in shape, their bases resting on the wall of the oögonium . Gradually the eggs become spherical and acquire a thick, hyaline membrane. When they first become spherical they show many oil globules situated on one side of the egg (fig. 10). These globules are at first only about 2μ in diameter, but they gradually fuse until there are only two or three larger ones from 8μ to 15μ in diameter. Finally these globules fuse into a single one, which is about 16μ in diameter, and situated at the periphery of the egg. The eggs are then ripe.

In old cultures an oögonium would often sprout a new one, the old being emptied into the new (fig. 9). This process might be repeated several times and the eggs be formed finally in the terminal oögonium (fig. 8).

Occasionally two oögonia were produced upon one branch, or an antheridial filament was found coming from an oögonial branch.

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EXPLANATION OF PLATE LXIII

Fig. 1. The tip of a main hypha showing the gnarled condition of the secondary hyphae. × 155.

Fig. 2. Main hypha showing sporangia and method of growth. × 155.

Fig. 3. Spores encysted within the thin-walled sporangium. × 700.

Fig. 4. Spores falling apart, the basal ring remaining. × 700.

Fig. 5. Usually large basal cup with a few spores still remaining in it. × 700.

Fig. 6. Oögonium containing fully ripe eggs. Empty antheridia attached to the wall of the oögonium. × 700.

Fig. 7. Young oögonium with antheridium full of protoplasm. × 700.

Fig. 8. Showing double branching below the sporangia; antheridial branches; and new oögonia formed from old ones. × 700.

Fig. 9. New oögonium forming from old one. × 700.

Fig. 10. Oögonium with young eggs and young antheridium. × 700.